Early retirement eligibility and employment behavior: evidence from a cohort based pension reform

preliminary version

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February 15, 2016

This paper analyzes the employment effects of a major pension reform in Germany using cohort discontinuities. In particular, we focus on the abolition of an early retirement option for women. Up until cohort 1951 women could draw old-age pensions starting with age 60. Women born after 1951 no longer had this opportunity. The eligibility age for early retirement was increased to 63. We exploit this reform in a regression discontinuity framework to study the effects on employment and program substitution. Our preliminary results suggest that the increase in the eligibility age for early retirement increased employment rates of older women. Remarkably, we do not find any significant spillover effects into alternative paths to exit the labor force. On the contrary, we find negative effects on reduced earnings capacity pension participation rates, and small insignificant effects on the unemployment rate of 60 year-old women. Furthermore, we find negative effects on social security program participation of women in their late 50s.

Keywords: Retirement age, Early retirement, Regression discontinuity, Unemployment, Labor supply, Disability pension
JEL Classification: J14, J26

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1 Introduction

The demographic transition puts financial pressure on pay-as-you-go pension systems around the world. Governments have answered to these challenges by reforming their pension systems. A central objective of these reforms is to delay retirement and to increase incentives to work longer. This policy extends the contributory period and reduces the number of beneficiaries at the same time. Typical pension reforms include tightening early retirement provisions and raising the statutory retirement age.

From a budgetary perspective it is important to empirically assess if these pension reforms created spillover effects in other government programs such as unemployment or disability insurance. Large spillovers could undermine the positive fiscal effects of the pension reform. However, these reforms might also have undesired distributional effects as the ability to work long and the remaining life expectancy may depend on socio-economic status. In particular, workers with health problems and weak labor market position might be negatively affected by fewer retirement options (Staubli, 2011).

The empirical evaluation of the incentive effects of social security systems on employment behavior is a complex task. Many studies directly model financial retirement incentives to estimate behavioral responses (the common approach in the literature builds on the option value model by Stock and Wise, 1990). These models are primarily identified by cross-sectional variation which limits the power of their identification (Coile and Gruber, 2007; Chan and Stevens, 2004). In particular estimates might be biased because unobserved retirement preferences are most likely correlated with program incentives. A possible solution to this problem are pension reforms which generate exogenous variation in the social security system and can be viewed as quasi-natural experiments. The design of pension reforms often includes a different treatment of adjacent birth cohorts which creates discontinuities along the year of birth in retirement incentives (Krueger and Pischke, 1992; Mastrobuoni, 2009; Staubli, 2011; Hanel and Riphahn, 2012; Atalay and Barrett, 2015). These cohort discontinuities have the advantage for empirical evaluation that endogenous sorting into treatment is ruled out and close birth cohorts share similar characteristics.

In our analysis we use a German pension reform that created a cohort discontinuity in the eligibility age for early retirement. In 1999 Germany decided to abolish an important early retirement program for women and restricted the access for all women born after 1952. Women with a sufficient employment history could claim retirement benefits as early as with age 60. The cohort born in 1951 was the latest cohort that could claim these benefits. The reform effectively raised the early retirement age for women to 63. Retirement before age 63 is only accessible for women with severe health problems. We exploit this sharp discontinuity to quantify the impact on female employment and to analyze if the reform lead to spillover effects in other programs such as the reduced earnings capacity (REC) pension or unemployment insurance. Moreover, we examine whether the behavioral reactions differ by socio-economic background and health, and asses the fiscal consequences of the raise in the early retirement age for women.

The sharp discontinuity in the eligibility age for early retirement allows to analyze this policy using a regression discontinuity design that compares employment behavior of women born in 1951 to those born in 1952. We not only focus on differences between cohorts after the age of 60 but take into account that the early retirement age also affects employment before age 60. We are mainly interested in the effects on employment, unemployment and the reduced earnings capacity pension program. We use high quality administrative data of the pension insurance records that include monthly information on employment status and income.

We contribute to a growing literature that analyzes pension reforms of the retirement age to study their behavioral impacts (e.g., Duggan et al., 2007; Karlström et al., 2008; Li and Maestas, 2008; Mastrobuoni, 2009; Coe and Haverstick, 2010; Staubli, 2011; Hanel and Riphahn, 2012; Staubli and Zweimüller, 2013; Borghans et al., 2014; Lalive and Staubli, 2014; Atalay and Barrett, 2015; Engels et al., 2016). These studies analyze the impact of changes of the eligibility age for early retirement, changes of the normal retirement age as well as changing financial incentives for early retirement. In addition to the effects on retirement age and employment several studies also aim to quantify spillover effects.

Staubli and Zweimüller (2013) is one of the few papers that explicitly analyzes an increase of the eligibility age for early retirement. They analyze an Austrian pension reform that gradually increased for men and women the eligibility age. Each quarter of birth the eligibility age increased by 2 months. They find a modest increase of employment and a substantial increase in registered unemployment for both men and women. They do not find large effects on disability take-up.

The paper proceeds as follows. Section 2 briefly outlines the German Federal Public Pension system and the 1999 pension reform. Section 3 describes the pension insurance record data which is used in our analysis. Section 4 describes our empirical strategy and Section 5 presents the results of the regression discontinuity and survival analysis. Finally, Section 6 concludes.

2 Institutional background

The German Federal Public Pension system is almost universal and covers about 90 percent of the working population and is by far the largest source of income after retirement entry. The public pension system can be divided into two classes: the mandatory retirement insurance for employees which is financed by contributions, and the tax-financed pension system for civil servants. Self-employed individuals can be exempt from the public retirement insurance. In this study, we focus on the employment decisions of individuals who are subject to public pension insurance contributions. Old-age pensions are designed to extend the standard of living achieved during working career; therefore they are roughly proportional to individual's average lifetime labor income and feature few redistributive properties.

The system is financed by a pay-as-you-go (PAYG) scheme, which is fed by contributions by the insured workers and their employers in equal parts. Individual benefit claims depend on the employment history using a system of premium points which are accumulated individually over the lifetime. One premium point corresponds to one year of average pension contributions. In the case of lower or higher than average contributions, the premium points credited are adjusted proportionally. All contributions are weighted equally over the lifetime.

The most important component of the Federal Public Pension is the old-age pension. For individuals born before 1947, the statutory old-age pension retirement age at which full pension benefits can be claimed is 65. Starting with the 1947 cohort, the full retirement age was gradually increase to 67 in monthly steps. Benefits can be drawn regardless of the employment status and no further contributions have to be paid after reaching the full retirement age (FRA). However, there are several exceptions that enable early retirement, before reaching the FRA, for some groups of workers.

There are four types of old-age pensions that can be claimed before reaching the full retirement age:

1. individuals who paid pension insurance contributions for at least 35 years can retire

early at age 63

2. a disability pension can be claimed by individuals, who have a severe disability status, at age 60[1]

3. unemployed individuals can retire at age 60 up to cohorts born in 1945, afterwards the ERA was increased gradually to 63

4. women are eligible for the women's old-age pension at age 60, if they fulfill relatively weak eligibility criteria

For those individuals who are not eligible for an old-age pension there are mainly two ways to exit the labor force early: by bridging the time to the earliest possible retirement entry by unemployment benefits, or by claiming a reduced earnings capacity pension (REC pension), which can be granted at any age before the FRA for a restricted time after a medical examination. Reduced earnings capacity is defined as the inability to work more than three hours per day at customary working conditions for an unforeseeable period of time, which will last for an indeterminate time. The REC pension is usually grated for a period of no longer than tree years, if the reduced earnings capacity is not very unlikely to cease.

There was no direct benefit reduction associated with early retirement before the pension reform process that started in 1992.[2] As a result, there was a strong incentive to retire early which can be observed in the data: only a third of the workers retires at the statutory retirement age (Deutsche Rentenversicherung, 2014). In the last two decades, several pension reforms have been implemented to reduce the financial burden and increase labor supply of older workers. One of the most important changes was effectuated by the 1992 pension reform, which introduced benefit deductions of 0.3 percent for each month of early retirement, up to a maximum of 18 percent. Most kinds of early retirement benefits are subject to deductions, including the old-age pension for women and the REC pension. The reform was gradually implemented but fully in place for the cohorts who are subject of this study (1944 onwards). A few years later, the 1999 pension reform, which will be subject of this analysis, abolished early retirement with age 60 for unemployed individuals and women.(an overview of pension reforms until 2003 can be found in Börsch-Supan and Wilke, 2004)

2.1 The 1999 pension reform

To cope with the increasing cost of early retirement in a country with an aging population, the 1999 pension reform was designed with the purpose to respond to demographic changes, distribute the financial burden more balanced over generations, and assure that the function of the public pension as main pillar of old-age income insurance can be preserved. The reform package entails multiple changes to the public pension system. The early retirement age of the disability pension was increased from 60 to 63 in monthly steps starting with individuals born in January 1952 and the old-age pension for the unemployed was abolished for all individuals born after 1951[3].

The 1999 reform also abolished the old-age pension program for women born after 1951. Women with a sufficient employment history could claim retirement benefits as early as at

[1] The minimum age for claiming disability pension was increased to 63 in monthly steps starting with individuals born in January 1952.

[2] There is an indirect benefit reduction resulting from less contribution years.

[3] The early retirement age for this pension was already increased from 60 to 63 for cohorts from 1948 onwards by an earlier pension reform.

age 60. The reform effectively raised the earliest retirement age for women to 63. Women born before 1952 can still request old-age pension benefits on their 60th birthday if they fulfill certain eligibility criteria. The eligibility criteria for claiming an old-age pension for women are, according to § 237a SGB VI, (i) a waiting period[4] of at least 15 years; (ii) at least 10 years of pension insurance contributions due to employment after the age of 40. These criteria ensure a minimum labor market attachment of eligible women. About 70 percent of all women born in 1951 were eligible for the old-age pension for women[5].

3 Data

We are using administrative data from the Research Data Center of the German Federal Pension Fund (*Deutsche Rentenversicherung*) on public pension insurance accounts. The VSKT (*Versicherungskontenstichprobe*) is a stratified random sample of all open pension insurance accounts and serves as a tool to calculate future pension benefit claims and monitor the financial development of the Federal Pension Fund. The population of pension insurance accounts contains everybody with at least one public pension insurance entry, who was at least 15 and at most 67 years old at the date of data collection. That excludes all people with different pension programs; among them miners, civil servants, self-employed, and people with foreign pensions and specific partial pensions. Individual observations are discontinued if the insurance account is closed, the individual reaches the maximum age of 68, the individual dies, or all contributions were paid and no new contributions are received.

The VSKT was initially sampled in 1983 and is since then continued as a panel containing monthly information on the individuals included in the sample [6]. Since the data is process-produced, recall errors due to memory gaps and wrong temporal assignment are avoided, panel mortality is negligible and non-response does not occur. Furthermore, individual employment behavior and retirement entry is reported with monthly accuracy. A drawback is that socio-economic variables are only recorded to the extent that they are relevant for the calculation of pension benefits. Consequently, information on education is missing in about half of the cases and children are only reported if individuals received child care credits, which is mostly the case for women. It is not possible to link partners and households within the data. Information about occupations is only available for the last occupation at the time of data collection, which may not be representative of entire employment histories.

For our analysis we use the anonymized scientific use file SUFVSKT 2013, which contains a 25 percent subsample of the VSKT, drawn randomly in December 2013. The SUFVSKT includes only German citizens aged 30 to 67 in December 2013, who live in Germany and were born between 1946 and 1983. The total number of individuals included in the 2013 wave of the SUFVSKT is 65,047. We use only women born between 1948 and 1952 who fulfill the eligibility criteria of the old-age pension for women. Our final sample contains 2,440 women, observed over 6 years (age 55 to age 61). In our main analysis, we further restrict the sample to the cohorts of 1951 and 1952, which amounts to 1,027 women and 73,944 person-months.

The SUFVSKT is stored in separate files for time-invariant information on background characteristics and current status information, and time-variant monthly information on individual employment histories. In our analysis, we combine the time-invariant part with

[4] Explain waiting period.

[5] Source: own calculations using SUFVSKT 2013.

[6] After 1983, new panel cases need to be added every year to have a representative sample of the general population. See methodological report (**?**) for a detailed description of the panel sampling methodology.

monthly social employment status (SES) information. The SES variable contains one status for each person in every biography month[7], and includes the following mutually exclusive categories: employed with social security contributions, unemployed, retired receiving old-age pension, reduced earnings capacity pension, education, professional training, providing non-commercial care, child raising, illness or work disability, military or civilian service, marginal employment, self-employed, and a category for all other status. The outcome variables of interest in this analysis are whether or not an individual is employed, unemployed, receiving an old-age pension, or receiving a reduced earnings capacity pension at any given age in months. An individual counts as employed if she had a job which was subject to social security contributions, which excludes marginal employment and self-employment in many cases. Unemployment comprises all periods were unemployment benefits were received. The definition of reduced earnings capacity pension participation makes use of both time-invariant and monthly SES information as the latter is not unambiguously defined. As displayed in Figure 1, among 55 to 59 year old-women born between 1948 and 1952, 53.1 percent are employed, 12.3 percent are unemployed and 6.4 percent receive a reduced earnings capacity pension.

Table 1: SES status of 55 to 59 year-old women by cohort, in percent

Cohort	Employed	Unemployed	REC pension
1948	51.8	13.4	14.2
1949	52.1	12.6	4.7
1950	53.6	12.2	5.3
1951	53.1	13.1	4.3
1952	54.6	10.1	4.4
Total	53.1	12.3	6.4

Source: SUFVSKT 2013

These fraction differ by cohort and age, as younger women are more likely to work for all age groups and employment rates decline with age. The distribution of SES status by age in months is displayed in Figure 1 for the 1951 cohort, and Figure 2 for the 1952 cohort. It can be seen that a large fraction of women born in 1951 receive an old-age pension from the month after their 60th birthday onwards. This fraction almost disappears if we look at the 1952 cohort due to the 1999 reform. A closer look at the fractions of women in different SES categories reveals that women born in 1950 and 1951 exhibit a large drop in employment rates when reaching age 60 (721 months), as well as a large drop in both unemployment rates and reduced earnings capacity pension rates (see Figure 4, Figure 5, and Figure 7), while these discontinuities are not observed for the cohort of 1952.

4 Empirical strategy

Our empirical strategy makes use of the 1999 pension reform, which eliminates the option to retire with age 60 for women born in 1952 and thereafter. We employ a regression discontinuity research design to estimate the effect of an increase in the early retirement age on employment rates, unemployment rates, and the fraction of older women receiving

[7]The variable part of the VSKT is stored in biography months. For each individual in the sample, the first observation is equal to January of the year in which the person became 14 years old. For our purposes, we recoded the data to contain monthly information by age in months. Furthermore, we created a variable that contains calendar time. SES categories are mutually exclusive. Parallel spells underlie a priority ranking described in detail in the methodological report.

a reduced earnings capacity pension. To evaluate whether the reform had an effect on women below the age of sixty, our specification allows us to estimate the reform effects on different age groups separately.

The standard RD framework is, however, not suitable for the estimation of reform effects on transition rates of working women above the age of 55 into unemployment and early retirement. In order to account for the problem of right-censoring of the observed employment and unemployment spells, we make use of duration models, which are widely used in the literature on retirement entry and unemployment exit.

The main identifying assumption of our analysis is that in the absence of the reform, the employment outcomes would have been the same between cohorts after controlling for age and pension eligibility criteria. In particular, we need to assume that differences between the cohorts in questions are not caused by other policy changes. Two other pension policy changes became effective for individuals born after January 1st, 1952. Firstly, the old-age pension for the unemployed was abolished for all individuals born after 1951 as part of the 1999 pension reform. However, the early retirement age for this pension was already increased from 60 to 63 for cohorts from 1948 onwards by an earlier pension reform. Secondly, the early retirement age of the disability pension was increased from 60 to 63 in monthly steps starting with individuals born in January 1952. We cannot distinguish the effect of the abolishment of the old-age pension for women from the effect of an increase ERA for the disability pension. However, we argue that the latter is likely to be negligible because the fraction of women eligible for disability pension is small, and eligibility criteria are not flexible. To support our argument, it can be seen in Figure 2 that only a very small fraction of women born in 1952 retires before reaching the new ERA. This fraction can be interpreted as women participating in the disability pension program because no other old-age pension was available for this cohort at this age.

4.1 Regression discontinuity approach

We implement a regression discontinuity research design by estimating the following empirical model:

$$y_i = \alpha + \beta D_i + \gamma_0 f(z_i - c) + \gamma_1 D_i f(z_i - c) + X_i'\delta + \epsilon_i$$

Where $D_i = 1$ if the individual was born after January 1952 and z_i is the month of birth, which enters the empirical model in difference to the last month of birth where the women's old-age pension was available. We try two different specifications, one with a linear trend in the running variable, where $f(z_i - c) = z_i - c$, and one with a quadratic function $f(z_i - c)$. Both specifications allow for different slopes before and after the cutoff. All regressions include calendar time quarter fixed effects, accumulated pension points and a dummy for West Germany. We estimate the effects on three monthly employment status outcomes of interest: employment, unemployment, and REC pension participation, which are defined as binary variables equal to one if an individual is recorded to have the corresponding social employment status (SES) in a given month. Furthermore, we analyze the reform effects on women below the age of 60 by including age-treatment interactions into our empirical model. The inclusion of age-dummies and interactions with the treatment variable $D_i = 1$, allows us to interpret the coefficient of the interaction term as the reform effect on a specific age group.

The RD design is only valid if women cannot manipulate the treatment assignment variable (Lee and Lemieux, 2010), which is the month of birth in our research design. Evidently, it is impossible that women or their parents manipulated the date of birth in

anticipation of the policy change, as the reform was introduced long after the cohorts in question were born. Furthermore, we are not aware of any changes in the incentive to give birth in 1951 as opposed to 1952. Women born 1952 may still be different from women born earlier due to time trends in employment outcomes. Employment rates of women have been increasing over the past decades for every age. Including linear and quadratic trends in birthdates should solve this problem in an RD research design, as long as we can assume that women who were born closely to the cutoff are not different from each other.

In another specification, we estimate the reform effect at the eligibility cutoff age of 60 years (720 months), by combining the discontinuity in employment trends by age with the difference in eligibility rules by cohort. This *differences-in-discontinuities* approach is implemented by estimating the following regression:

$$y_{it} = \delta_0 + \delta_1 f(x_t) + \gamma_0 T_t + \gamma_1 T_t f(x_t) + J_i[\alpha_0 + \alpha_1 f(x_t) + \beta_0 T_t + \beta_1 T_t f(x_t)],$$

where x_t is equal to age in months, normalized to zero in the month of the 60th birthday, $T_t = 1$ if the individual crosses the age threshold of 60 years (age in months > 720) and $D_i = 1$ if the individual was born after January 1st, 1952. The treatment effect is estimated by the coefficient β_1 of the interaction term $D_i * T_t$. The *differences-in-discontinuities* estimator $\hat{\beta}_1$ can be interpreted as the reform effect at the eligibility cutoff age. However, we are more interested in the total effect of the entire age group, instead of the jump at the cutoff. The results of the *differences-in-discontinuities* approach can nevertheless be found in the appendix.

4.2 Survival analysis

To estimate transition rates of older employed women into unemployment and retirement, we implement a duration model. Starting point is the cumulative distribution function of employment spells,

$$F(t) = Prob[T \leq t],$$

where t is a random duration time, equal to age in months starting at age 55 in our case, and T is the failure time. The function $F(t)$ can be interpreted as the probability that the spell is to end within duration t. The corresponding probability distribution function is denoted $f(t) = dF(t)/dt$. From $F(t)$ we can easily derive the survivor function $S(t) = Prob[T > t] = 1 - F(t)$, which can be interpreted as the probability that the duration of the spell exceeds t. From the probability distribution and the survivor function, we can derive the hazard function

$$\lambda(t) = f(t)/S(t),$$

which is the instantaneous probability of leaving a state, conditional on survival to time t. We aim to estimate the hazard function of exiting the labor force at high age. The hazard function can be estimated using different model specifications. An obvious non-parametric discrete time estimate is the number of spells ending at time t divided by the number of observations at risk of ending at time t. However, we are not solely interested employment exits, but rather want to know whether women exit into unemployment or early retirement. Consequently, we implement a competing risk model between two mutually exclusive alternatives. The advantage of this specification is that it does not require failure types to be independent of each other. For this specification to be valid, we have to assume that employment exit is an absorbing state. Furthermore, there should be no unobserved heterogeneity between women born in 1951 and 1952.

In addition to an analysis of employment exits, another outcome of interest is the transition rate from unemployment into reemployment. It is plausible to expect an increase in the reemployment probability of older women due to the prolonged time span until the earliest retirement entry is possible. We will apply a competing risk model, similar to (**?**), to estimate the hazard rate of leaving unemployment into reemployment or retirement.

5 Results

5.1 Preliminary regression discontinuity results

Women who don't have the option to retire at age 60, even though they would have retired in the absence of the 1999 reform, necessarily have to divert into another employment status. It can be seen in Figure 1 that women born in 1951 enter the old-age pension program not only from employment, but also from unemployment, the REC pension program, and other categories summarized in the residual. A mechanical positive reform effect on several social employment categories can therefore be expected, when comparing 60 year-olds born before and after the reform cutoff birthdate.

While the positive effect on the fractions of women in most other SES categories in lack of the option to retire early can be interpreted as mechanical, we are interested in answering the question of the magnitude of the reform effect on labor supply of 60 year-old women[8]. Both older workers and their employers may have grown accustomed to an early retirement age of 60 for women. Coworkers and other peers of women born after the reform-cutoff may still be able to retire early. If labor supply of older women were inelastic, we would expect women to exit the labor force around the age of 60 despite the unavailability of an early old-age pension. As a result we would expect a reform-induced increase in unemployment and REC pension participation rates for women around the age of 60, who were previously employed.

The elimination of the old-age pension for women is equivalent to an increase in the early retirement entry age. Consequently, women who are affected by the reform face an expected extension of the time horizon until an old-age pension is available. The expected extension varies between 3 years, in the case of early retirement with 63, and 5.5 years in the case of retirement at the full retirement age of 65 years and 6 months. A minimum of three additional years of future labor income increases the expected utility from lifetime labor income and thereby decreases the incentives to exit the labor force. Therefore, we expect an increase in the employment rates of women due to an ERA increase, even before reaching the former early retirement age of 60. Note that the reform was introduced in 1999, while the first affected cohorts reached age 60 only in 2012. Consequently, the ERA increase was no surprise for the affected cohorts. On the contrary, there was enough time to adapt employment behavior according to the new expected earliest age of retirement entry.

It is quite common for older German workers to exit employment a few years before reaching the ERA. Bridging the time from employment exit to retirement entry by unemployment benefits or the REC pension program is often supported by employers, and is facilitated by relatively generous unemployment benefits *Arbeitslosengeld I*, which are paid up to two years to older workers, and the REC pension benefits, which are usually granted for a maximum of three years. An increase in the ERA leads to an extension of the bridge period that is likely to be costly for both employer and employees, if employment exit is

[8] At this time, data for older women is not yet available. However, we may be able to add an analysis of the employment behavior of 61 and 62 year-old women when newer data waves become available.

not delayed. If women who are affected by the reform instead adjust their employment behavior and delay their (bridge into) retirement, we expect a negative effect on unemployment and REC pension rates for women approaching age 60, in particular among 57 to 59 year-olds.

The results of the RD analysis of the reform effect on employment rates are displayed in Table 2. The ERA increase had a positive effect of about 15.7 percentage points on the employment rate of 60 year-old women. Including a quadratic function of month of birth does not alter the result considerably. The coefficients of treatment and a specific age group can be interpreted as the percentage point increase (or decrease) in employment rates of this age group due to exposure to the reform. The results suggest that employment rates of 56 and 59 year-old women increased slightly, although not significantly for all age groups and specifications. Figure 10a to 10d visualize the local linear RD estimates of the reform effect on employment rates of 57 to 60 year-olds. Column (2) and (3) of Table 2 repeat the analysis for a restricted sample of women who were employed with age 55, and women who were unemployed with age 55 respectively. Women who were employed with age 55 are even more likely to be employed with age 60 due to the reform, and significantly more likely to be employed when they are 58 and 59. Even though the point estimate is slightly smaller for women who were unemployed at age 55, the reform seem to have increased the employment rate at age 60 compared to women who were born before 1952. However, we cannot follow that the reemployment probability increased. The effect may simple be due to an unchanged reemployment probability combined with an early employment exit of those women who got reemployed but were eligible for the old-age pension with age 60. A survival analysis will provide a deeper understanding of the changes in reemployment probabilities of older unemployed women due to the ERA increase.

Descriptive evidence suggests that unemployment rates increased around age 60 among women who weren't eligible for the early old-age pension (see Figure 5). However, this could be due to general trends in unemployment rates. An RD analysis allows the estimation of causal effects by exploiting the discontinuity in unemployment rates by month of birth. The RD estimates of the effects on unemployment rates of older women are displayed in Table 3, and Figure 12a to 12d. The coefficients on unemployment rates of 60 year-old women are positive but insignificant. Note that an increase in unemployment and REC pension program rates can be solely due to the fact that many women switched from these programs into the old-age pension program before the reform. In order to evaluate the effectiveness of the reform, we are interested in the effect on women who were previously employed. For previously employed women, the coefficient is small and insignificant. The empirical evidence does not suggests the existence of spillover effects into unemployment benefits due to an increase in the ERA. We find negative effects of -3.8 to -4.4 percentage points on unemployment rates of 58 and 59 year-olds respectively. However, the coefficients of unemployment rates of 56 and 57 year-olds are positive, and in the case of previously unemployed women quite substantial in magnitude. A possible explanation is that the 1951 cohort delayed unemployment to age 58 or 59, which enabled them to receive unemployment benefits until retirement entry. Another explanation, consistent with the results for the effects on REC pension participation, is that women in the 1951 cohort change from unemployment into the REC pension program at high rates in their late 50s.

The results of the RD analysis of the reform effect on the fraction of older women receiving REC pension benefits is displayed in Table 4, and Figure 14a to 14d. We find negative effects on REC pension participation rates of 60 year-old women, ranging from -2.5 to -5.5, which provides evidence against the existence of spillover effects. In the case of women who were employed at age 55 the effect is almost zero, suggesting that employed

women are not more likely to enter REC pension due to the reform. In contrast, 60 year-old women who were previously unemployed are 7 percentage points more likely to receive REC pension benefits due to the ERA increase. This is not surprising since unemployed women entered the old-age pension at the earliest possible age in absence of the reform. Consistent with the expected response to an extension of the time horizon until an old-age pension is available, we find negative effects of -2.8 to -9.0 percentage points on REC rates of 58 and 59 year-olds respectively. These effects are even larger for those women who were unemployed with age 55. However, previously employed women are slightly more likely to receive REC pension benefits in their late 50s due to the reform.

[*Analysis by region, health status, and employment history is to be completed*]

5.2 Survival analysis results

[*To be completed*]

5.3 Fiscal consequences

Given the thorough analysis of the effects of the 1999 reform, we can quantify the effects of the reform on public finances.

[*To be completed*]

6 Conclusion

We study how a strong increase in the ERA for women affect labor supply, unemployment and REC pension take-up. We identify a causal impact of ERA using variation from a pension reform in Germany from 1999. The reform effectively increased the ERA for all women born after 1952 from 60 to 63. Women born until 1951 were not affected by this reform. The sharp discontinuity in the ERA by cohort allows us to analyze the behavioral responses using a regression discontinuity design. This reform is interesting because it restricts the opportunity set for women near the retirement age. Previous studies have shown that labor market exits increase significantly at the age of first eligibility for pension benefits. If women shift their employment exit to the new ERA, it might an effective tool to raise old-age employment. However it could imply that some women who are not able to extend their working life are adversely affected by this reform.

Preliminary results suggest that the increase in the ERA had a large and positive impact on employment rates of older women. Not only are 60 year-old women 15.6 percentage points more likely to be employed, but the ERA increase seems to have led to higher employment rates of women in their late 50s as well. A central result of our empirical model is also that we do not find spillover effects into alternative social security programs. On the contrary, we find negative effects on reduced earnings capacity pension rates, ranging from -2.5 to -5.5, and a small and insignificant effect on unemployment rates of 60 year-old women.

Consistent with the expected response to an extension of the time horizon until an old-age pension is available, we find negative effects of -2.8 to -9.0 percentage points on REC pension participation rates of 56 to 59 year-olds. The effect on unemployment rates of women in their late 50s is ambiguous. Smaller unemployment rates of 58 and 59 year olds and larger unemployment rates of 56 and 57 year-olds suggest that women who could receive old-age pension benefits at age 60 may have exited employment one or two years before reaching age 60, bridging the time until retirement entry by unemployment benefits.

While our preliminary results suggest that the ERA increase achieved its intended goals without large spillovers into other social security programs, we yet have to explore whether these effects differ by region, health and employment history.

References

Atalay, K. and Barrett, G. F. (2015). The impact of age pension eligibility age on retirement and program dependence: Evidence from an australian experiment. *Review of Economics and Statistics*, 97(1):71–87.

Borghans, L., Gielen, A. C., and Luttmer, E. F. P. (2014). Social Support Substitution and the Earnings Rebound: Evidence from a Regression Discontinuity in Disability Insurance Reform. *American Economic Journal: Economic Policy*, 6(4):34–70.

Börsch-Supan, A. and Wilke, C. B. (2004). The german public pension system: how it was, how it will be. Technical report, National Bureau of Economic Research.

Chan, S. and Stevens, A. H. (2004). Do changes in pension incentives affect retirement? a longitudinal study of subjective retirement expectations. *Journal of Public Economics*, 88(7):1307–1333.

Coe, N. B. and Haverstick, K. (2010). Measuring the spillover to disability insurance due to the rise in the full retirement age. *Boston College Center for Retirement Research Working Paper*, (2010-21).

Coile, C. and Gruber, J. (2007). Future social security entitlements and the retirement decision. *The review of Economics and Statistics*, 89(2):234–246.

Deutsche Rentenversicherung (2014). Rentenversicherung in Zeitreihen 2014. DRV-Schriften 22.

Duggan, M., Singleton, P., and Song, J. (2007). Aching to retire? the rise in the full retirement age and its impact on the social security disability rolls. *Journal of Public Economics*, 91(7):1327–1350.

Engels, B., Geyer, J., and Haan, P. (2016). Labor supply and the pension system - evidence from a regression kink design. Mimeo.

Hanel, B. and Riphahn, R. T. (2012). The timing of retirement – new evidence from swiss female workers. *Labour economics*, 19(5):718–728.

Karlström, A., Palme, M., and Svensson, I. (2008). The employment effect of stricter rules for eligibility for DI: Evidence from a natural experiment in Sweden. *Journal of Public Economics*, 92(10–11):2071–2082.

Krueger, A. B. and Pischke, J.-S. (1992). The Effect of Social Security on Labor Supply: A Cohort Analysis of the Notch Generation. *Journal of Labor Economics*, 10(4):412–37.

Lalive, R. and Staubli, S. (2014). How does raising women's full retirement age affect labor supply, income and mortality? evidence from switzerland.

Lee, D. S. and Lemieux, G. F. (2010). Regression discontinuity designs in economics. *Journal of Economic Literature, American Economic Association*, 48(2):281–355.

Li, X. and Maestas, N. (2008). Does the rise in the full retirement age encourage disability benefits applications? evidence from the health and retirement study. *Evidence from the Health and Retirement Study (September 1, 2008). Michigan Retirement Research Center Research Paper*, (2008-198).

Mastrobuoni, G. (2009). Labor supply effects of the recent social security benefit cuts: Empirical estimates using cohort discontinuities. *Journal of Public Economics*, 93(11):1224–1233.

Staubli, S. (2011). The impact of stricter criteria for disability insurance on labor force participation. *Journal of Public Economics*, 95(9–10):1223–1235.

Staubli, S. and Zweimüller, J. (2013). Does raising the early retirement age increase employment of older workers? *Journal of public economics*, 108:17–32.

Stock, J. H. and Wise, D. A. (1990). Pensions, the option value of work, and retirement. *Econometrica*, 58(5):1151–80.

7 Appendix

7.1 Descriptive statistics: graphs of SES categories by age in months

Figure 1: Employment status by age in months: cohort 1951

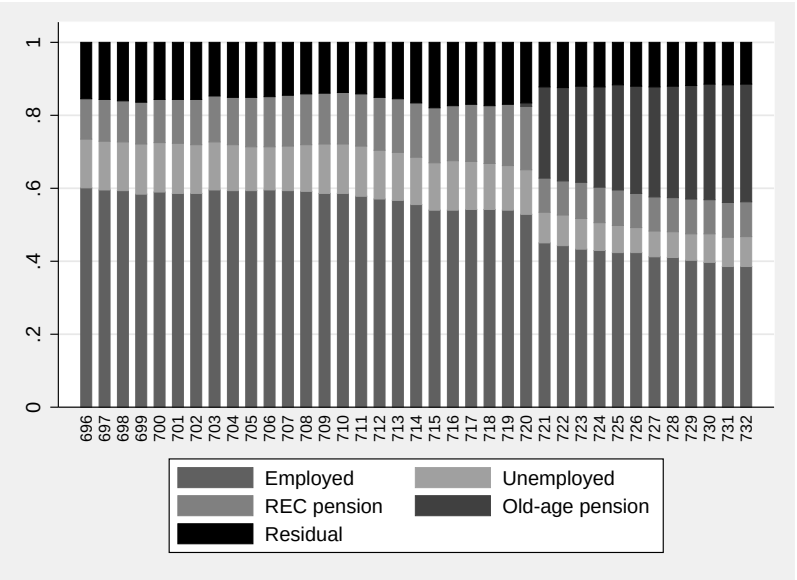


Figure 2: Employment status by age in months: cohort 1952

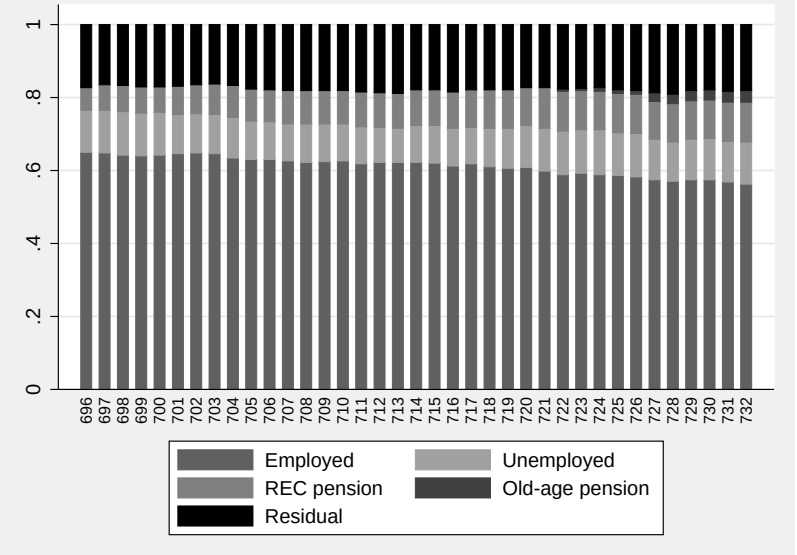


Figure 3: Old-age pension recipient rate by age and cohort

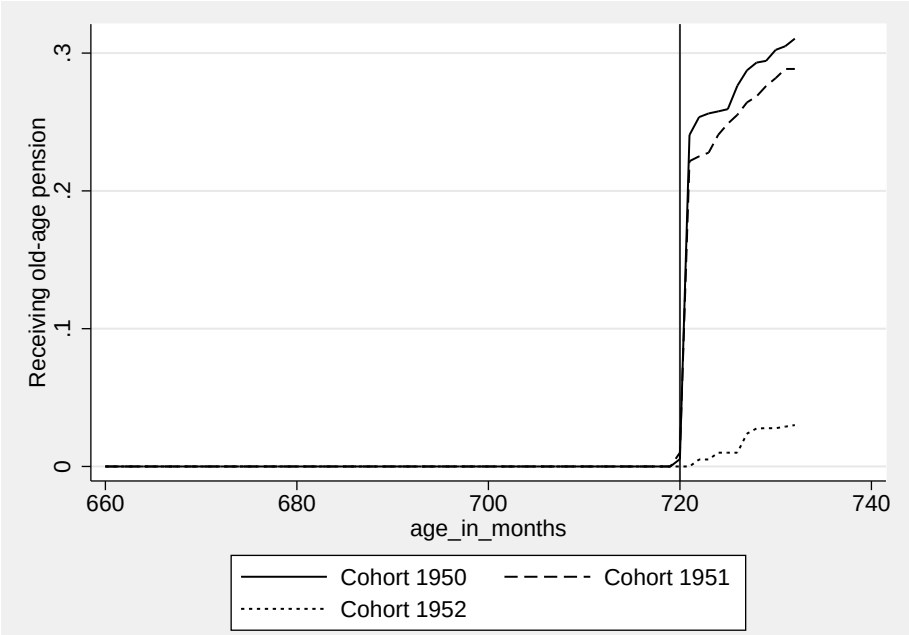


Figure 4: Employment rate by age and cohort

Figure 5: Unemployment rate by age and cohort

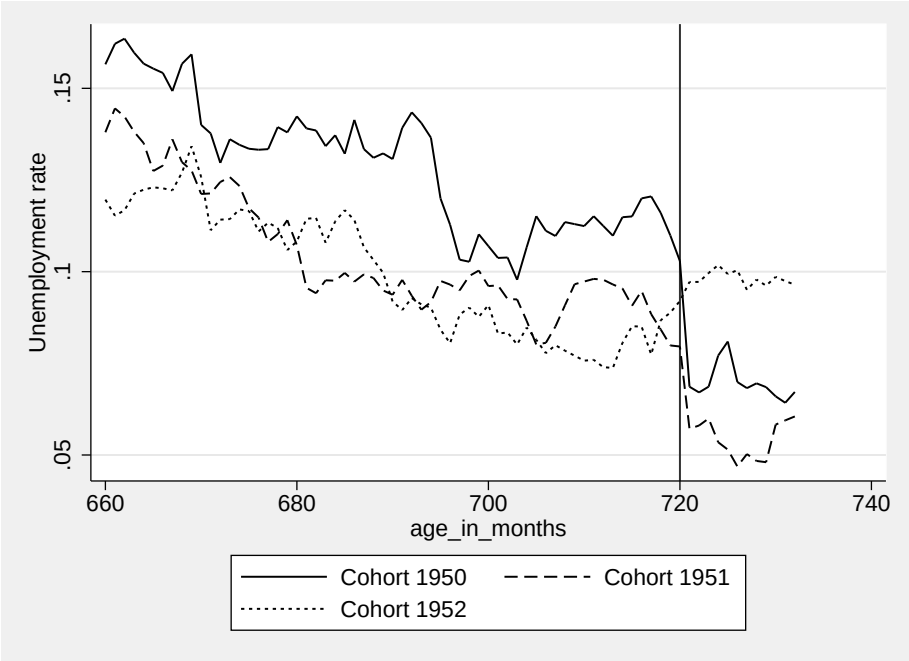
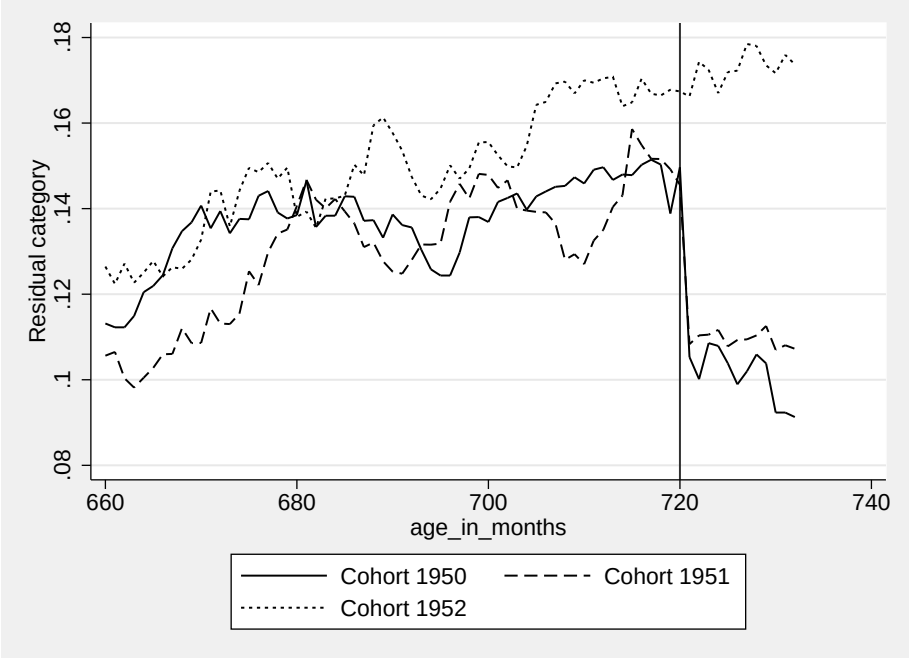


Figure 6: Reduced earnings capacity pension recipients by age and cohort

Figure 7: Combined pension recipients (old-age and REC pension) by age and cohort

Figure 8: Residual category, summarizing all categories except employment, pensions, unemployment and disability pensions, by age and cohort



7.2 Regression discontinuity results

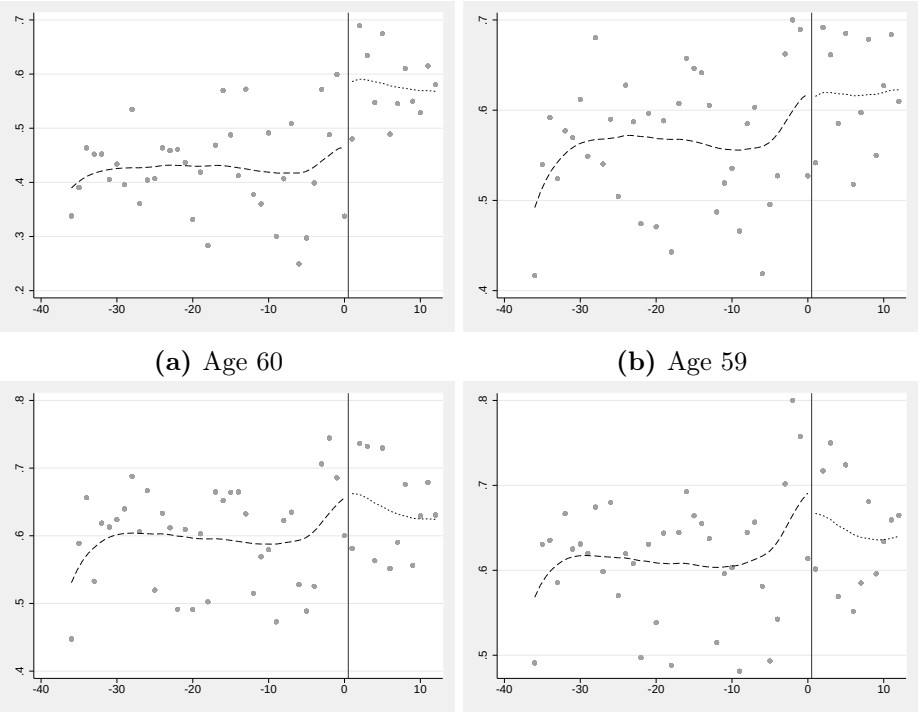
Table 2: Effect on employment rates of different age groups

	(1)	(2)	(3)	(4)
VARIABLES	Linear	Employed	Unemployed	Quadratic
$D_i * Age60$	0.157**	0.183***	0.123*	0.160**
	(0.0068)	(0.0004)	(0.0097)	(0.0060)
$D_i * Age59$	0.027	0.018*	0.040	0.043
	(0.0054)	(0.0027)	(0.0114)	(0.0070)
$D_i * Age58$	0.035*	0.040***	-0.004	0.065*
	(0.0047)	(0.0004)	(0.0064)	(0.0060)
$D_i * Age57$	0.008	-0.006**	0.002	0.042
	(0.0045)	(0.0003)	(0.0172)	(0.0075)
$D_i * Age56$	0.005	-0.002	-0.020***	0.041*
	(0.0014)	(0.0026)	(0.0000)	(0.0058)
mob	0.018	0.014	0.010	0.031
	(0.0071)	(0.0047)	(0.0025)	(0.0202)
Constant	-0.417	0.581**	-0.266	-0.433
	(0.1375)	(0.0284)	(0.0502)	(0.1270)
Observations	73,944	52,272	16,488	73,944
R-squared	0.158	0.081	0.049	0.159

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: We try two different specifications one with a linear trend in the running variable (1), and one with quadratic trends (4). Both specifications allow for different slopes before and after the cutoff. Column (2) and (3) include only women who were employed/unemployed for at least one month when they were 55 years old. All regressions include calendar time quarter fixed effects, accumulated pension points and a dummy for West Germany.

Figure 9: Employment rate by age and month of birth (January 1952=0)



(a) Age 60 **(b)** Age 59

(c) Age 58 **(d)** Age 57

Notes: The scatter plot is based on monthly averages by month of birth. The lines are drawn using local linear regression with triangular kernels and a bandwidth of 12 months.

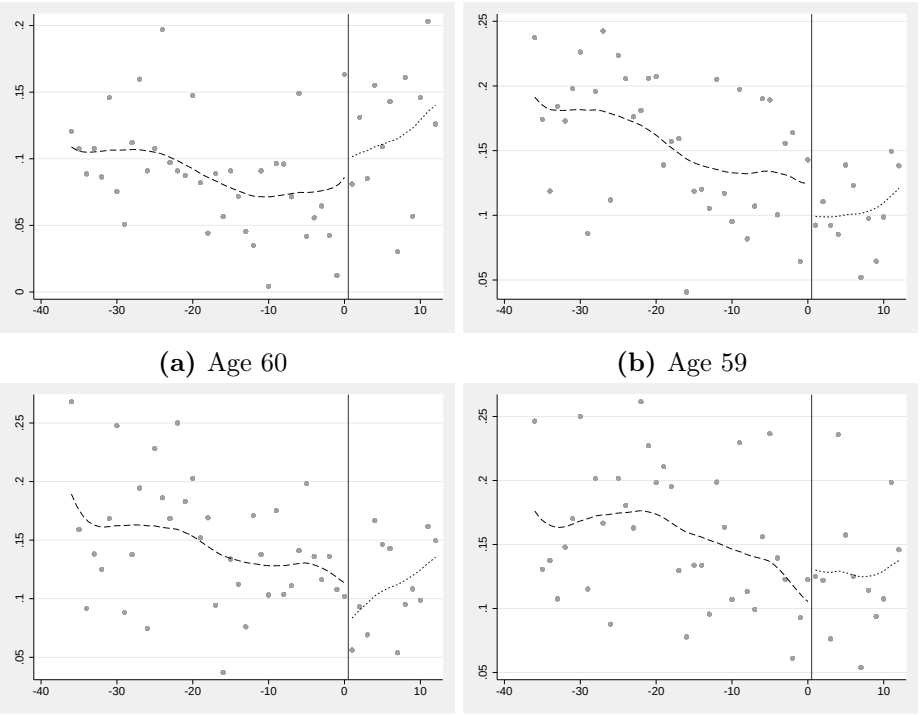
Table 3: Effect on unemployment rates of different age groups

	(1)	(2)	(3)	(4)
VARIABLES	Linear	Employed	Unemployed	Quadratic
$D_i * Age60$	0.007	0.013	0.010	0.015
	(0.0024)	(0.0039)	(0.0303)	(0.0036)
$D_i * Age59$	-0.044**	-0.003	-0.157	-0.004***
	(0.0009)	(0.0020)	(0.0367)	(0.0000)
$D_i * Age58$	-0.038*	-0.028***	-0.038	-0.038*
	(0.0032)	(0.0001)	(0.0205)	(0.0038)
$D_i * Age57$	0.009	0.015**	0.132	0.042**
	(0.0017)	(0.0005)	(0.0428)	(0.0030)
$D_i * Age56$	0.037	0.039*	0.149*	0.061**
	(0.0067)	(0.0051)	(0.0131)	(0.0027)
mob	0.001	0.002	-0.001	-0.000
	(0.0013)	(0.0020)	(0.0043)	(0.0023)
Constant	0.428*	0.204**	0.971	0.444*
	(0.0418)	(0.0092)	(0.2494)	(0.0614)
Observations	73,944	52,272	16,488	73,944
R-squared	0.041	0.013	0.141	0.041

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: We try two different specifications one with a linear trend in the running variable (1), and one with quadratic trends (4). Both specifications allow for different slopes before and after the cutoff. Column (2) and (3) include only women who were employed/unemployed for at least one month when they were 55 years old. All regressions include calendar time quarter fixed effects, accumulated pension points and a dummy for West Germany.

Figure 11: Unemployment rates by age and month of birth (January 1952=0)



(a) Age 60 **(b)** Age 59

(c) Age 58 **(d)** Age 57

Notes: The scatter plot is based on monthly averages by month of birth. The lines are drawn using local linear regression with triangular kernels and a bandwidth of 12 months.

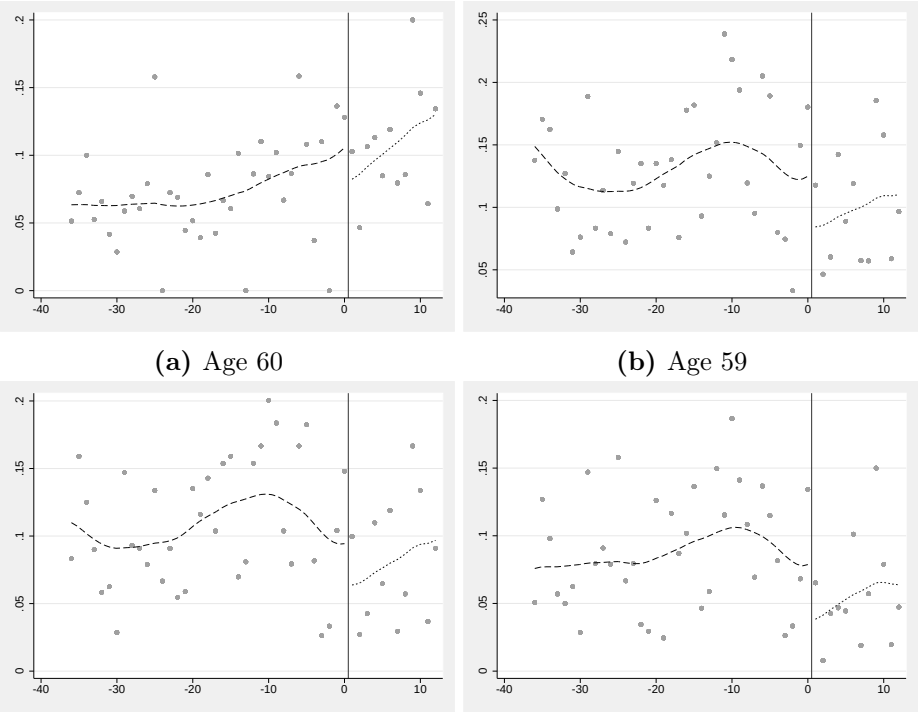
Table 4: Effect on reduced earnings capacity pension rates of different age groups

	(1)	(2)	(3)	(4)
VARIABLES	Linear	Employed	Unemployed	Quadratic
$D_i * Age60$	-0.025*	0.004*	0.070*	-0.055**
	(0.0031)	(0.0005)	(0.0088)	(0.0039)
$D_i * Age59$	-0.030**	0.013*	-0.019**	-0.090**
	(0.0021)	(0.0019)	(0.0012)	(0.0039)
$D_i * Age58$	-0.028*	0.021*	-0.089*	-0.067**
	(0.0042)	(0.0024)	(0.0094)	(0.0042)
$D_i * Age57$	-0.037**	0.024**	-0.156**	-0.085**
	(0.0014)	(0.0010)	(0.0040)	(0.0039)
$D_i * Age56$	-0.046**	0.005**	-0.125**	-0.067**
	(0.0020)	(0.0001)	(0.0046)	(0.0037)
mob	-0.001	-0.000	0.004	0.010
	(0.0005)	(0.0012)	(0.0026)	(0.0054)
Constant	0.251	0.062*	0.162	0.253
	(0.0468)	(0.0065)	(0.0690)	(0.0625)
Observations	73,944	52,272	16,488	73,944
R-squared	0.046	0.028	0.083	0.048

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: We try two different specifications one with a linear trend in the running variable (1), and one with quadratic trends (4). Both specifications allow for different slopes before and after the cutoff. Column (2) and (3) include only women who were employed/unemployed for at least one month when they were 55 years old. All regressions include calendar time quarter fixed effects, accumulated pension points and a dummy for West Germany.

Figure 13: REC pension rates by age and month of birth (January 1952=0)



(a) Age 60 **(b)** Age 59

(c) Age 58 **(d)** Age 57

Notes: The scatter plot is based on monthly averages by month of birth. The lines are drawn using local linear regression with triangular kernels and a bandwidth of 12 months.

7.3 Difference-in-discontinuities results

Table 5: Net effect on employment rate when reaching age 60

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Linear	Quadratic	Fixed effects	West Germany	East Germany
$D_i * T_t$	0.089***	0.056***	0.089***	0.065**	0.126***
	(0.0099)	(0.0035)	(0.0093)	(0.0218)	(0.0160)
Age_{it}	-0.005*	-0.008**	-0.001**	-0.004	-0.009**
	(0.0018)	(0.0017)	(0.0007)	(0.0034)	(0.0031)
T_t	-0.100***	-0.070***	-0.099***	-0.092***	-0.112***
	(0.0057)	(0.0018)	(0.0038)	(0.0104)	(0.0055)
$Age_{it} * T_t$	-0.003***	-0.003**	-0.003***	-0.003*	-0.003*
	(0.0005)	(0.0010)	(0.0005)	(0.0012)	(0.0013)
$Age_{it} * D_i$	0.001**	0.005***	0.001***	0.000	0.002**
	(0.0002)	(0.0006)	(0.0001)	(0.0002)	(0.0005)
$Age_{it} * D_i * T_t$	0.008***	0.007***	0.003**	0.010*	0.001
	(0.0017)	(0.0010)	(0.0015)	(0.0038)	(0.0039)
Year of Birth = 1949	0.032	0.034		0.057	-0.041
	(0.0216)	(0.0214)		(0.0388)	(0.0366)
Year of Birth = 1950	-0.004	-0.003		0.025	-0.108
	(0.0426)	(0.0427)		(0.0776)	(0.0785)
Year of Birth = 1951	-0.048	-0.048		-0.029	-0.160
	(0.0644)	(0.0644)		(0.1184)	(0.1189)
Year of Birth = 1952	-0.015	0.016		0.020	-0.185
	(0.0849)	(0.0882)		(0.1621)	(0.1620)
Constant	-0.658***	-0.658***	0.631***	-0.297	-1.528***
	(0.1319)	(0.1333)	(0.0662)	(0.2188)	(0.1780)
Observations	175,680	175,680	175,680	114,840	60,840
R-squared	0.166	0.166	0.077	0.154	0.211
Number of id			2,440		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: We include cohort and calendar time quarter fixed effects, as well as the accumulated pension points and a dummy for West Germany in the baseline specification. In specification (3), we include individual fixed effects instead of time-invariant characteristics. In specification (4), we only include women who potentially fulfill the eligibility criteria for the women's old-age pension, regardless of age and year of birth. Standard errors are clustered by year of birth.

Table 6: Net effect on unemployment rate when reaching age 60

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Linear	Quadratic	Fixed effects	West Germany	East Germany
$D_i * T_t$	0.054***	0.072***	0.056***	0.042***	0.079**
	(0.0111)	(0.0121)	(0.0091)	(0.0085)	(0.0258)
Age_{it}	0.002	0.003	-0.001	0.002	0.003
	(0.0018)	(0.0016)	(0.0007)	(0.0017)	(0.0024)
T_t	-0.049**	-0.060***	-0.050***	-0.030*	-0.089***
	(0.0126)	(0.0105)	(0.0038)	(0.0115)	(0.0173)
$Age_{it} * T_t$	-0.002***	-0.003	-0.001***	-0.002	-0.002
	(0.0002)	(0.0015)	(0.0005)	(0.0008)	(0.0013)
$Age_{it} * D_i$	-0.001**	-0.003**	-0.001***	-0.000	-0.002***
	(0.0002)	(0.0008)	(0.0001)	(0.0004)	(0.0003)
$Age_{it} * D_i * T_t$	-0.005*	-0.005*	-0.001	-0.005*	-0.003
	(0.0019)	(0.0022)	(0.0014)	(0.0022)	(0.0030)
Year of Birth = 1949	-0.016	-0.017		-0.017	-0.008
	(0.0214)	(0.0222)		(0.0193)	(0.0284)
Year of Birth = 1950	0.005	0.005		0.005	0.021
	(0.0443)	(0.0453)		(0.0394)	(0.0609)
Year of Birth = 1951	0.016	0.016		0.020	0.031
	(0.0669)	(0.0675)		(0.0602)	(0.0918)
Year of Birth = 1952	0.006	-0.011		0.020	0.006
	(0.0895)	(0.0856)		(0.0869)	(0.1215)
Constant	0.579***	0.580***	0.109*	0.434***	0.775***
	(0.0941)	(0.0966)	(0.0651)	(0.0857)	(0.1341)
Observations	175,680	175,680	175,680	114,840	60,840
R-squared	0.042	0.042	0.016	0.015	0.035
Number of id			2,440		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: We include cohort and calendar time quarter fixed effects, as well as the accumulated pension points and a dummy for West Germany in the baseline specification. In specification (3), we include individual fixed effects instead of time-invariant characteristics. In specification (4), we only include women who potentially fulfill the eligibility criteria for the women's old-age pension, regardless of age and year of birth. Standard errors are clustered by year of birth.

Table 7: Net effect on reduced earnings capacity pension rate when reaching age 60

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Linear	Quadratic	Fixed effects	West Germany	East Germany
$D_i * T_t$	0.056***	0.052***	0.057***	0.061***	0.050**
	(0.0086)	(0.0073)	(0.0060)	(0.0107)	(0.0156)
Age_{it}	0.002	0.002	0.002***	0.002	0.003
	(0.0016)	(0.0018)	(0.0004)	(0.0027)	(0.0017)
T_t	-0.063***	-0.060***	-0.062***	-0.070***	-0.049**
	(0.0059)	(0.0054)	(0.0025)	(0.0065)	(0.0111)
$Age_{it} * T_t$	-0.002**	-0.002*	-0.002***	-0.002*	-0.002
	(0.0007)	(0.0008)	(0.0003)	(0.0008)	(0.0010)
$Age_{it} * D_i$	-0.000	0.000	-0.000***	-0.000	-0.000
	(0.0001)	(0.0005)	(0.0001)	(0.0002)	(0.0003)
$Age_{it} * D_i * T_t$	-0.004**	-0.004***	-0.001	-0.006**	0.000
	(0.0010)	(0.0006)	(0.0009)	(0.0019)	(0.0011)
Year of Birth = 1949	-0.023	-0.023		-0.028	-0.001
	(0.0178)	(0.0177)		(0.0313)	(0.0184)
Year of Birth = 1950	-0.022	-0.022		-0.020	-0.003
	(0.0356)	(0.0354)		(0.0626)	(0.0392)
Year of Birth = 1951	0.009	0.009		0.020	0.021
	(0.0536)	(0.0535)		(0.0945)	(0.0572)
Year of Birth = 1952	-0.038	-0.034		-0.038	0.009
	(0.0700)	(0.0674)		(0.1219)	(0.0673)
Constant	0.437**	0.436**	0.130***	0.357	0.845***
	(0.1180)	(0.1181)	(0.0425)	(0.1886)	(0.1074)
Observations	175,680	175,680	175,680	114,840	60,840
R-squared	0.047	0.047	0.034	0.040	0.097
Number of id			2,440		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: We include cohort and calendar time quarter fixed effects, as well as the accumulated pension points and a dummy for West Germany in the baseline specification. In specification (3), we include individual fixed effects instead of time-invariant characteristics. In specification (4), we only include women who potentially fulfill the eligibility criteria for the women's old-age pension, regardless of age and year of birth. Standard errors are clustered by year of birth.